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BATTLEFIELD AUTOMATION

Acquisition Issues Facing the Army Battle Command, Brigade and Below Program

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The Honorable C.W. Bill Young
Chairman
National Security Subcommittee
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

The Army plans to increase the exchange of information on the battlefield through the Force XXI Battle Command, Brigade and Below (FBCB2) Program.[1] The goal is to "digitize" the forces—create an automated information network at the brigade level and below by installing computers on individual battlefield platforms and linking those computers by radio. The Army plans to equip a division with this capability by the end of fiscal year 2000.

As requested, we reviewed the Army's acquisition plans for FBCB2. Specifically, we evaluated the program's significance to the Army's battlefield digitization goal, the Army's derivation of cost estimates, and the feasibility of the Army's fielding schedule. We also collected information on experimental performance results to date.

Background

FBCB2 will be the principal digital command and control system for the Army at the brigade level and below and will constitute the third major component of the Army's Battle Command System. Currently, the Battle Command System comprises the (1) Global Command and Control System-Army located at strategic and theater levels, which interoperates with other theater, joint, and multinational command and control systems, and with Army systems at the corps and levels below and (2) Army Tactical Command and Control System, which meets the command and control needs from corps to battalion.

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[1]Army pamphlet 10-1, Organization of the United States Army, June 1994, describes "brigade and below" as follows: the brigade (3,000-5,000 soldiers), battalion (300-1,000 soldiers), company (62-190 soldiers), platoon (16-44 soldiers), squad (9-10 soldiers), and the individual soldier.

When fielded, FBCB2 is expected to provide enhanced situational awareness to the lowest tactical level[2]—the individual soldier—and a seamless flow of command and control information across the battle space. To accomplish these objectives, FBCB2 will be composed of

- a computer that can display a variety of information,[3] including a common picture of the battlefield overlaid with graphical depictions (known as icons) of friendly and enemy forces;
- software that automatically integrates Global Positioning System data, military intelligence data, combat identification data, and platform data (such as the status of fuel and ammunition); and
- interfaces to communications systems.

Battlefield data will be communicated to and received from users of FBCB2 through a "Tactical Internet." This is a radio network comprising the Enhanced Position Location Reporting System (EPLRS) and the Single Channel Ground and Airborne Radio System (SINCGARS). By connecting platforms through this Tactical Internet, data needed for battlefield situational awareness and command and control decisions can be made available to commanders at all levels of the Army's Battle Command System.

To explore the FBCB2 concept, the Army acquired and installed sufficient quantities of equipment to field a brigade-size experimental force in June 1996. This experimental force then used FBCB2 prototype equipment in an Advanced Warfighting Experiment, which culminated in March 1997 during a 2-week deployment against an opposing force at the National Training Center, Fort Irwin, California. Results from the Advanced Warfighting Experiment were considered sufficiently positive that the Army conducted an FBCB2 milestone I/II review in July 1997.[4] FBCB2 was

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[2]The Army describes "situational awareness" as near real time information on current unit positions and their tactical/logistical status. Also, intelligence sources will enable a continuous flow of information on enemy locations and intelligently derived and widely disseminated analysis of probable enemy intent.

[3]Platforms such as the M1A2 Abrams tank and the M2A3 Bradley Fighting Vehicle, which already have an on-board data processing capability, will not require another computer. Instead, the FBCB2 "embedded battle command" software will be used to interface with existing software. Other platforms will require FBCB2 computers. In November 1997, the Army's acquisition objective was 2,604 embedded FBCB2 systems and 59,522 systems requiring computer installations.

[4]Department of Defense (DOD) Regulation 5000.2R explains that the acquisition process shall be structured in logical phases separated by major decision points called milestones. In general, an acquisition program will progress through four milestones. These milestones are: milestone 0, approval to conduct concept studies; milestone I, approval to begin a new acquisition program; milestone II, approval to enter engineering and manufacturing development; and, milestone III, approval for production or fielding/deployment.

conditionally approved for entry into the engineering and manufacturing development acquisition phase (acquisition milestone II) pending completion of certain essential action items, including the final Operational Requirements Document and the Test and Evaluation Master Plan. The program is expected to incur life-cycle costs of about $3 billion (in then-year dollars) by fiscal year 2012.

DOD Regulation 5000.2R offers a general model for management of the acquisition process for programs such as FBCB2. This regulation states that managers shall structure a program to ensure a logical progression through a series of phases designed to reduce risk, ensure affordability, and provide adequate information for decision-making. At the start of a program, consideration is given to program size, complexity, and risk and a determination is made regarding acquisition category. More costly, complex, and risky systems are generally accorded more oversight. The determination made at program initiation is reexamined at each milestone in light of then-current program conditions.

The regulation describes the differences among acquisition categories and places them in one of three categories: I, II, or III. In general, the milestone decision authority for category I programs is at a higher level than category II or III programs. In addition, category I programs generally require that more information—such as an Analysis of Alternatives[5] and a Cost Analysis Improvement Group[6] review—be available for decision-making. Category I programs are defined as programs estimated by the Under Secretary of Defense for Acquisition and Technology to require eventual expenditure for research, development, test, and evaluation of more than $355 million (fiscal year 1996 constant dollars) or procurement of more than $2.1 billion (fiscal year 1996 constant dollars). Category II programs have lower dollar classification thresholds than category I programs; for example, the research, development, test, and evaluation dollar threshold for an acquisition category II program is

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[5]DOD Regulation 5000.2R requires an analysis of alternatives for all acquisition I programs. These analyses are intended to (1) aid and document decision-making by illuminating the relative advantages and disadvantages of alternatives being considered and (2) show the sensitivity of each alternative to possible changes in key assumptions (e.g., threat) or variables (e.g., selected performance capabilities). Discussions of interoperability and commonality of components/systems that are similar in function to other DOD component programs or Allied programs are sometimes included. The analysis shall aid decisionmakers in judging whether any of the proposed alternatives to an existing system offer sufficient military and/or economic benefit to be worth the cost. There shall be a clear linkage among the analysis of alternatives, system requirements, and system evaluation measures of effectiveness.

[6]The Cost Analysis Improvement Group is part of the Office of the Secretary of Defense, the Program Analyses and Evaluation Office, and their reviews are used to ensure cost data of sufficient accuracy are available to support reasonable judgments on affordability for acquisition I programs.

$140 million (fiscal year 1996 constant dollars). Category III programs are defined as those which do not meet the criteria for category I or II programs. FBCB2 is currently classified as a category II acquisition program.

Results in Brief

On the basis of the Army's estimate of FBCB2 research, development, test, and evaluation costs, the program has been classified as a category II acquisition—one that does not require systematic oversight by the Under Secretary of Defense for Acquisition and Technology. We believe that because of the FBCB2's significance, cost, and schedule risk, the FBCB2 should be classified as a category I acquisition and receive a higher level of oversight. Specifically:

- Although FBCB2 is critical to the Army's digitization plan—the system ties the upper level command and control systems to the digital battlefield—FBCB2 is the only major system in the Army's Battle Command System that has not been designated category I. The system's potential to provide thousands of soldiers with the ability to send and receive clear and consistent battlefield information in almost real time demonstrates the system's significance as a linchpin of the digital battlefield. This significance is confirmed by the Army's own designation of FBCB2 as one of the highest priority command and control systems and the Army's plan to equip a division with an FBCB2 capability by the end of fiscal year 2000.
- Our analysis indicates that there are additional research, development, test, and evaluation costs that, when included, increase the dollar significance of this program to a category I acquisition level.
- The FBCB2 program faces significant schedule risk in meeting the fiscal year 2000 mandate for fielding the first digitized division. The mandate was set by the Army Deputy Chief of Staff for Operations and Plans in August 1997. To achieve this schedule, the FBCB2 program will, in a 18-month period, need to pass a series of tests, including two operational tests. Each test requires different versions of software for each of the two hardware components—the computer and the communications interface unit. Additionally, new versions of two weapon systems participating in the FBCB2 operational tests—the Abrams tank and the Bradley Fighting Vehicle—will be concluding their own operational tests just prior to the start of FBCB2 operational testing. The Army acknowledges that the program schedule is high risk. However, despite this acknowledged schedule risk, the Army is moving ahead with its highly compressed schedule with no apparent risk management strategy specifically addressing alternatives and the implications of not fielding an adequately developed system by the end of fiscal year 2000.

Because the FBCB2 program has only recently entered engineering and manufacturing development, no operational evaluations are yet available for analysis. However, the 1997 Task Force XXI Advanced Warfighting Experiment employed a prototype FBCB2. Two independent organizations, the Army's Operational Test and Evaluation Command and the Office of the Secretary of Defense, Operational Test and Evaluation Office, assessed FBCB2 results and found a number of problems. These included poor message completion, limitations related to the experimental hardware and software, a lack of adequate digital connectivity, immaturity of the Applique—the Army's name for the FBCB2 computer—and the Tactical Internet, and inadequate training. These organizations offered recommendations for the continued development, maturity, and oversight of upcoming FBCB2 operational tests. Army officials currently assess the program's technical risk as medium.

Program Significance, Estimated Cost, and Schedule Risk Indicate Need for Higher Level Systematic Oversight

FBCB2 is currently designated a category II acquisition on the basis of the Army's estimate of research, development, test, and evaluation costs. As a result, oversight is provided within the Army. We believe that the program should be a category I acquisition on the basis of (1) significance of the program; (2) estimated research, development, test, and evaluation costs; and (3) high schedule risk. The Army acknowledges that the program schedule involves high risk.

FBCB2 Is a Priority One Army Program

Throughout the next decade and beyond, the Army plans to modernize its forces through an overarching initiative called Force XXI. Components of the Force XXI initiative are Army XXI, which extends to about the year 2010, and the Army After Next, which is looking beyond the year 2010. Included within the modernization objectives of Army XXI is the integration of information technologies to acquire, exchange, and employ timely information throughout the battle space.

In general, integrated situational awareness and command and control information technologies available to Army commanders currently extend through the Army Tactical Command and Control System to tactical operations centers at the brigade and battalion levels. By extending the integration of information technologies to the thousands of soldiers operating outside the tactical operations centers, the Army expects to increase the lethality, survivability, and operational tempo of its forces.

FBCB2 is the critical link needed to extend the information to those soldiers.

On August 1, 1997, the Deputy Chief of Staff for Operations and Plans announced that the first digitized division would be the 4th Infantry Division and that, at a minimum, fielded equipment would include the Army Training and Doctrine Command's list of priority one systems and associated equipment. The Training and Doctrine Command has identified 15 priority one systems. They primarily consist of command, control, and communications systems, including FBCB2. It is considered a critical element within the Army's digitization effort because of the contribution it makes to achieving the required capabilities for the digitized battlefield. Approved by the Joint Requirements Oversight Council of the Joint Chiefs of Staff in January 1995, these capabilities are

- integrated battle command from platoon to corps,
- relevant common picture of the battle space at each level,
- smaller units that are more lethal and survivable,
- more responsive logistics within and between theaters, and
- joint interoperability at appropriate levels.

It is unlikely that all of the required capabilities of the digitized battlefield can be achieved without FBCB2. However, despite this critical role, the Army has not designated FBCB2 as a category I acquisition—a designation it has given to the other major systems in the Army's Battle Command System.

The significance of this program has also been noted by the Office of the Secretary of Defense, Operational Test and Evaluation Office, which in October 1997 recommended that FBCB2 be elevated to an acquisition category I-D status on the basis of the program's "significant and far-reaching impact[7]." That office placed FBCB2 on the same level as the Army's Maneuver Control System, which is also an acquisition category I-D program. The Maneuver Control System is a key component of the Army's Tactical Command and Control System that provides automated critical battlefield assistance to commanders and their battle staff at the corps-to-battalion level.

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[7]The "D" refers to the Defense Acquisition Board, which advises the milestone decision authority, the Under Secretary of Defense for Acquisition and Technology. Other category I programs are designated I-C programs; the "C" refers to the Component Head or Component Acquisition Executive as the milestone decision authority.

Cost Estimate Does Not Include All Program Costs

The Army's cost estimate for research, development, test, and evaluation activities, adjusted to fiscal year 1996 constant dollars,[8] is $265.4 million. This estimate covers the period from fiscal year 1997 through fiscal year 2004. However, we believe the Army's estimate is understated in that other research, development, test, and evaluation costs should be added. As shown in table 1, these costs raise the research, development, test, and evaluation cost estimate above the category I threshold of $355 million.

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[8]To make the adjustments, we used the inflation indexes published by the Army Material Command on December 27, 1996.

Table 1: Our Estimate of Total FBCB2 Research, Development, Test, and Evaluation Costs

Dollars in millions

Cost category	Then-year estimate	Conversion factor	Fiscal year 1996 estimate
Research, development, test, and evaluation costs included in Army's life-cycle cost estimate (1998 dollars)	$283.4	1.0424	$271.9
Less: adjustment for fiscal year 1998 (1998 dollars)	(6.8)	1.0424	(6.5)
Subtotal of Army estimated costs			**$265.4**
Additional relevant costs identified			
Sunk costs included in Army life-cycle cost estimate (1998 dollars)	48.7	1.0424	46.7
Adjustment for fiscal year 1999 (1999 dollars)	5.5	1.0643	5.2
Warfighter Rapid Acquisition Program			
Applique (1997 dollars)	4.3	1.0210	4.2
Applique (1998 dollars)	2.6	1.0424	2.5
Warfighter Rapid Acquisition Program			
Tactical Internet (1997 dollars)	8.0	1.0210	7.8
Tactical Internet (1998 dollars)	8.0	1.0424	7.7
Expected transfer to Abrams program manager (1999 dollars)	14.2	1.0643	13.3
Expected transfer to Bradley program manager (1999 dollars)	3.5	1.0643	3.3
Estimated cost of FBCB2 limited user test (1998 dollars)	8.5	1.0424	8.2
Estimated cost of FBCB2 initial operational test and evaluation			
(1999 dollars)	15.4	1.0643	14.5
(2000 dollars)	7.5	1.0867	6.9
Subtotal of our additional costs			**$120.3**
Total			**$385.7**

We discussed these figures with Army program officials, and they agreed with $7.2 million of our additional costs, which included partial amounts from the Warfighter Rapid Acquisition Program[9] related to the FBCB2 computer—$2 million of the fiscal year 1997 ($1.4 million) and 1998

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[9]The Warfighter Rapid Acquisition Program started with a $50-million fiscal year 1997 appropriation for Force XXI Initiatives. The fiscal year 1997 funding was followed by a fiscal year 1998 appropriation of nearly $100 million. The Force XXI Initiatives funding was intended to allow the Army to accelerate the fielding of promising technologies.

($0.6 million)—and a $5.2-million difference between what was included in the life-cycle cost estimate ($47 million) and the actual budget request ($52.5 million) converted to 1996 constant dollars.

Army officials disagreed with the addition of remaining cost categories amounting to $113.1 million on the basis that (1) Army policies and procedures require them to include only those funds obligated by the program office after the establishment of a formal acquisition program; (2) FBCB2-related funds obligated by other program managers, such as the Abrams and Bradley managers, should be excluded; and (3) costs directly related to test and evaluation activities for acquisition category II, like FBCB2, are identified in the Army's Operational Test and Evaluation Command's Support of Operational Testing program element. Our assessment of the Army's arguments follows.

Funds Used to Buy Prototype Hardware and Software Should Be Included

The Army Digitization Program provided $47.6 million for FBCB2 research, development, test, and evaluation activities through fiscal year 1996. The funds used were to buy FBCB2 prototype hardware and software used in the Advanced Warfighting Experiment at the National Training Center. Army officials stated that these funds were obligated prior to the establishment of the FBCB2 acquisition program and thus should not be included in this cost estimate. We found that the Army had included these funds in its total life-cycle cost estimate and, while the source of the funds was the digitization program element, the explanation to the Congress in appropriate descriptive summaries shows the funds were needed for activities related to the development of FBCB2 hardware and software. Therefore, we believe these funds should be included in the derivation of the FBCB2 research, development, test, and evaluation cost estimate.

Funds for Integration Activities and Obligated by Abrams and Bradley Program Managers Should Be Included

Our analysis shows that $2.8 million in fiscal year 1997 funding and $1.9 million in fiscal year 1998 funding were specified for FBCB2 platform (shown as Applique in table 1)[10] integration activities and obligated by Abrams and Bradley program managers. Army officials stated that a new Army regulation requires that all platform-related costs be identified as part of the total platform cost and that these funds were given to and obligated by the Abrams and Bradley program offices. However, the Army obtained these funds from the Warfighter Rapid Acquisition Program on the basis that they would be used to provide an improved design that was

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[10]The Applique funding provided to the Army by the Warfighter Rapid Acquisition Program was accounted for in two ways. For fiscal year 1997, the adjusted amount of $4.2 million was apportioned as $1.6 million to the FBCB2 program element and $2.8 to the Abrams and Bradley program managers. In fiscal 1998, the adjusted amount of $2.5 million was apportioned as $0.6 million to the FBCB2 program element and $1.9 million to the Abrams and Bradley program managers.

not part of the original FBCB2 budget. Additionally, when requesting these funds, the Army stated that, without this funding, FBCB2 would be at risk of not meeting its fiscal year 2000 deadline. In our opinion, since these funds were specifically requested, used, and obligated for FBCB2, they should be considered part of the total research, development, test, and evaluation cost estimate.

Our analysis also shows that $7.8 million in fiscal year 1997 and $7.7 million in fiscal year 1998 were requested to complete system engineering and integration work on the Tactical Internet. According to Army officials, these funds were obligated by program managers for Tactical Radio Command Systems and Warfighter Information Network-Terrestrial and, since they were not controlled or obligated by the FBCB2 program manager, should not be included in the estimate. We believe these funds should be included as part of the FBCB2 research, development, test, and evaluation cost because the Army justified its need for these funds on the basis that they would be used to correct known shortcomings and make the Tactical Internet compatible with the evolution of the FBCB2 software development effort. In describing the critical nature of the funding, the Army concluded that without the Tactical Internet there would be no FBCB2.

We also found that interface funding is specifically characterized in the fiscal year 1999 Army descriptive summary for the Digitization Program element as needed to complete integration, procure prototypes, and initiate testing of FBCB2 in the M1A1 Abrams, the M1A2 Abrams with system enhancements, and the M2A2 Bradley Operation Desert Storm configurations. Therefore, we believe these funds are more appropriately categorized as FBCB2-related rather than research, development, test, and evaluation activities unique to the Abrams or Bradley platforms.

Test and Evaluation Costs Are Already Identified in Another Program Element

According to Army policy, test and evaluation costs associated with a category I program are included in the program element. Since we believe FBCB2 should be classified as a category I acquisition, we included $8.5 million in fiscal year 1998 for the FBCB2 Limited User Test, $15.4 million in fiscal year 1999 for the FBCB2 Initial Operational Test and Evaluation, and $7.5 million in fiscal year 2000 for the FBCB2 Initial Operational Test and Evaluation. We were unable to determine the estimated costs for Force Development Test and Evaluation. Had we been able to do so, these costs would also be included in our estimate.

Our belief that FBCB2 is justifiably a category I acquisition on the basis of cost is shared by an office in the Under Secretary of Defense for Acquisition and Technology. In November 1997, the Director, Test, System Engineering, and Evaluation, recommended that FBCB2 be designated a category I-D program because of "significant integration risks with other major systems and the potential dollar thresholds involved." The Director noted that cost estimates do not include communications and integration costs that potentially will drive the program above category II thresholds. We believe examples of these types of costs discussed in this report are communication costs associated with the Tactical Internet and integration costs associated with the Abrams and Bradley platforms.

Army program management officials expressed concern about a category I-D designation for the FBCB2 program because it would require the insertion of formal oversight review milestones, with their consequent resource demands, into an already risky schedule. However, our recent discussions with these officials disclosed that issues of cost estimates and acquisition category are still being explored. For example, a comprehensive Army cost estimate, currently being developed with help of the Cost Analysis Improvement Group, is expected to be available by September 1998. According to these officials, the FBCB2 Overarching Integrated Product Team is trying to reach a consensus on a recommendation regarding the appropriate amount of oversight required for the program. That recommendation may await the outcome of the Army's cost estimate effort currently being developed.

FBCB2 Schedule Is High Risk

To achieve the Army's end of fiscal year 2000 schedule, the FBCB2 program will need to pass a series of tests, including two operational tests. Additionally, new versions of two weapon systems participating in the FBCB2 operational tests will be concluding their own testing just prior to the start of FBCB2 operational testing. The Army acknowledges that the program schedule involves high risk. However, despite this acknowledged schedule risk, the Army is moving ahead with its highly compressed schedule without specifically addressing the implications of not fielding an adequately developed system by the end of fiscal year 2000.

Delays in Documenting Requirements and Complex Testing Schedule

In its effort to move the program rapidly along to meet the year 2000 implementation deadline, the Army is making decisions that may prove troublesome later in the acquisition. In this regard, we found that the development of critical acquisition documentation and plans are experiencing significant delays. For example, in July 1997 the Army made

the decision to move FBCB2 to acquisition milestone II (Engineering and Manufacturing Development) contingent on completion of the Operational Requirements Document and the Test and Evaluation Master Plan by November 1, 1997. In November 1997, these actions had not been completed and the new expected approval date for these documents slipped to March 1998. Our discussions with Army officials now indicate that these documents are not expected to be complete and approved by the Joint Requirements Oversight Council until July 1998. This means that the Army is currently relying on a December 1997 Training and Doctrine Command-approved Operational Requirements Document as the basis for the program until it is replaced by the Joint Requirements Oversight Council-approved Operational Requirements Document. Therefore, the requirements process is expected to conclude only 1 month prior to the start of the first FBCB2 operational test—Limited User Test—in August 1998.

Further, to meet the Army's fiscal year 2000 schedule, the FBCB2 program will need to successfully complete a series of tests, including two operational tests. Each test requires different versions of software for each of the two hardware components—the computer and the communications interface unit. The second operational test also requires that FBCB2 software be successfully integrated into the new digitized versions of the Abrams tank and the Bradley Fighting Vehicle. The new versions of these platforms will be concluding their own independent operational test and evaluations—to demonstrate the capability of the platforms as weapon systems—just prior to the start of the FBCB2 Initial Operational Test and Evaluation. These scheduled activities are shown in figure 1.

Figure 1: FBCB2 Schedule and Related Information
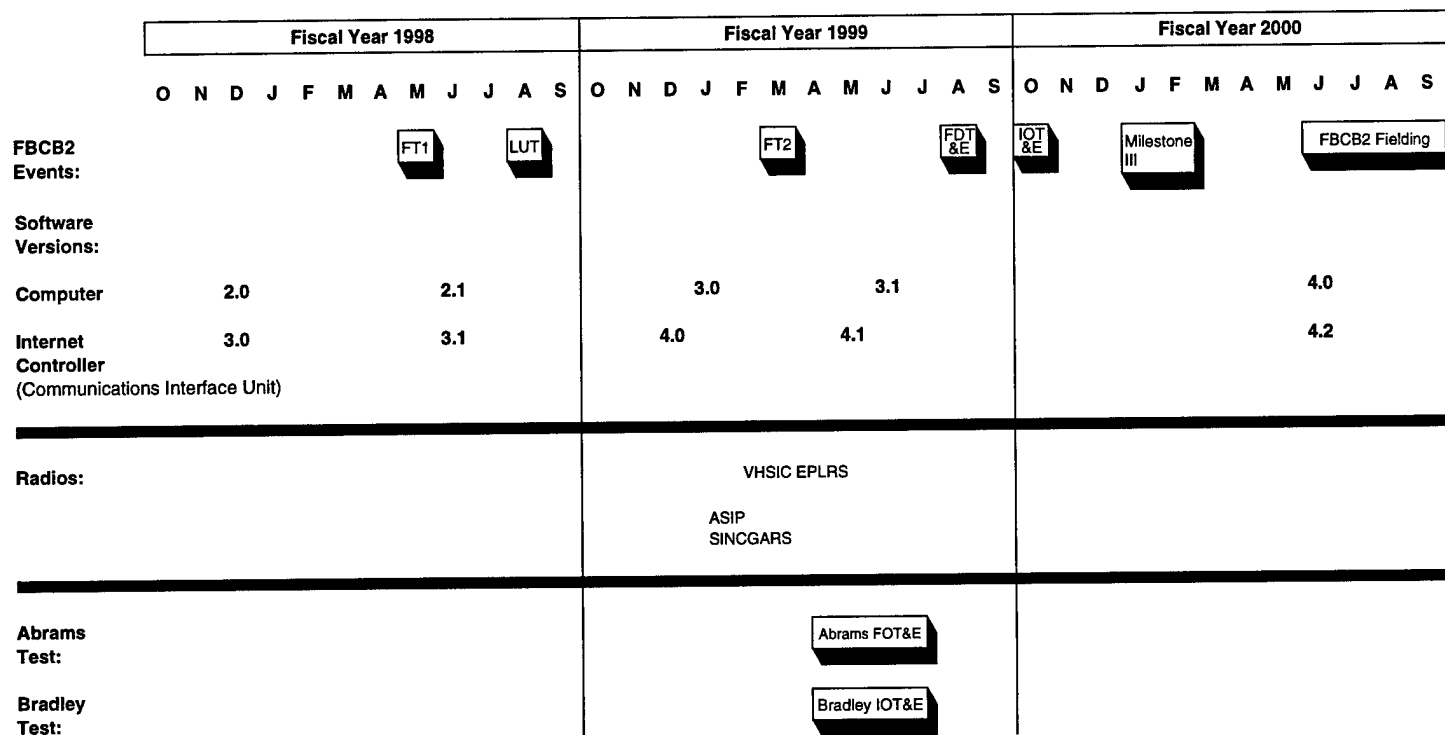
Legend:
ASIP SINCGARS — Advanced System Improvement Program SINCGARS
FDT&E — Force Development Test and Evaluation
FT — Field Test
IOT&E — Initial Operational Test and Evaluation
LUT — Limited User Test
VHSIC EPLRS — Very High Speed Integrated Circuit EPLRS
2.0 through 4.2 — Versions of software for computer and Internet controller

Source: FBCB2 Program Office.

Successful Completion of Current Test Schedule Is Questionable

As shown in figure 1, between now and the planned fielding in fiscal year 2000, FBCB2 will undergo two field tests, two operational tests, and one force development test. Throughout the test period, four different versions of software for the computer and communications interface unit will be used, with a fifth version actually fielded to the first digitized

division.[11] In an effort to reduce risk, the Army will be employing "spiral software builds"[12] throughout the test period. According to program officials, spiral software builds increasingly integrate the data from other systems, such as the Army Tactical Command and Control System, into the FBCB2 system. Each version is expected to add new functionality into the previous versions, thus building upon the existing baseline.

A field test is currently being conducted prior to the start of the Limited User Test and another will be held in 1999 prior to the Force Development Test and Evaluation. The main objectives of these field tests are to determine FBCB2 readiness for the Limited User Test and the Force Development Test and Evaluation and to make necessary modifications to the FBCB2 software.

The first operational test will be the Limited User Test scheduled for the last quarter of fiscal year 1998. Its main objective is to test new hardware and software developed since the conclusion of the Task Force XXI Advanced Warfighting Experiment. The new version of the FBCB2 computer is called "Applique +."[13] One limitation of the test is that only "appliqued platforms"—the Abrams M1A1D and the Bradley M2A2 Operation Desert Storm configurations—will be used. No newer digitized platforms, such as the Abrams M1A2 or the Bradley M2A3 configurations (which require FBCB2 embedded battle command software only), will be used.[14]

The Force Development Test and Evaluation is scheduled for the last quarter of fiscal year 1999. The purpose of the test is to evaluate the tactics, techniques, and procedures established for two digitized brigades of the 4th Infantry Division. At this point, it is not clear which configurations of weapon platforms will participate in this test.

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[11]The fifth software versions (4.0 for the computer and 4.2 for the internet controller) are actually versions 3.1 for the computer and 4.1 for the internet controller upgraded as a result of the Force Development Test and Evaluation and the Initial Operational Test and Evaluation.

[12]The spiral model of software development and enhancement was introduced by Barry W. Boehm in 1988. It is intended to reduce software development risks by recognizing the need to build incremental systems.

[13]During the Task Force XXI Advanced Warfighting Experiment, four versions of prototype computers were used: (1) a commercial version; (2) a ruggedized version; (3) a militarized version; and, (4) a version that could be used by dismounted soldiers. Ruggedized versions of the prototype computer will also be used during the Limited User Test.

[14]The older versions of the Abrams tank and the Bradley Fighting Vehicle do not have on-board computers that can be augmented by adding FBCB2 software. The older versions need to have a computer installed or integrated into the platform. The newer versions of the Abrams tank and the Bradley Fighting Vehicle do have on-board computers that can be augmented by FBCB2 embedded battle command software.

The second operational test is the Initial Operational Test and Evaluation for FBCB2 and is scheduled for the first quarter of fiscal year 2000. The testing is intended to demonstrate that the FBCB2 system is operationally effective, suitable, and survivable, and the results will be used to support the FBCB2 production decision. While it is expected that some Abrams and Bradley configurations using the FBCB2 embedded battle command software will be available for this test, the latest draft version of the FBCB2 Test and Evaluation Master Plan acknowledges that not all embedded FBCB2 platforms (for example, Land Warrior, Paladin, Crusader, and selected aviation platforms) are expected to be available to participate in the test. The majority of these platforms are still in development and cannot be tested until follow-on operational test and evaluation events.

In addition to the various software versions, the Army will be introducing new versions of two radios into the test events—an Advanced SINCGARS System Improvement Program radio and the EPLRS Very High Speed Integrated Circuit radio. Although the development of these radios has been closely coordinated with the demands of the Tactical Internet and FBCB2, they remain separately managed and funded programs. Synchronizing the radios' schedule with FBCB2's aggressive schedule remains a challenge. Overlaying the introduction of new hardware, software, and radios will be new doctrine, tactics, techniques, and procedures associated with using these new capabilities.

We believe that the introduction of so many new and diverse elements—hardware, software, radios, doctrine, tactics, techniques, and procedures—over the 18-month period of testing, coupled with the Army's expectation that the first division will be equipped by the end of fiscal year 2000, results in a highly complex and aggressive FBCB2 schedule. Both the Army Digitization Office and FBCB2 program office officials acknowledge that the aggressive schedules to mature and integrate multiple systems pose a high risk for successful program completion. In our opinion, risk is further heightened because there is no apparent risk mitigation strategy addressing the implications of the Army's not meeting the goal of having a functional digitized division by the end of fiscal year 2000.

Abrams and Bradley Program Managers Are Concerned About FBCB2 Testing Schedule

Compounding the FBCB2 schedule risk is the test schedule for the only two weapon platforms scheduled to be involved in FBCB2 initial operational testing. The M1A2 Abrams with system enhancements and the M2A3 Bradley will be undergoing their own independent operational testing during the FBCB2 engineering and manufacturing development phase. Specifically:

- The M1A2 Abrams tank with system enhancements is scheduled for a follow-on operational test and evaluation April-July 1999. As a risk mitigation measure, an early version of the FBCB2 embedded battle command software, version 1.02b, will be used to evaluate the interface between FBCB2 and the platform software. Command and control functionality will not be tested until the FBCB2 Initial Operational Test and Evaluation in October 1999.
- The M2A3 Bradley Fighting Vehicle is also scheduled for an Initial Operational Test and Evaluation April-July 1999. The Bradley test will not use any FBCB2 software. As with the Abrams, command and control functionality will not be tested until the FBCB2 Initial Operational Test and Evaluation in October 1999.

For FBCB2 operational testing, both Abrams and Bradley platforms will use embedded battle command software version 3.1.

Officials from both the Abrams and Bradley offices highlighted the development of the interface between their intravehicle digitized systems and the FBCB2 software as a concern. According to these officials, the newer versions of the Abrams and the Bradley are already digitized in that they have an on-board data processing capability, including mission-critical software. These officials were uncertain about the impact of introducing the FBCB2 software into the platforms. Training and fielding concerns were also expressed by these officials. Abrams officials further noted that their experiences indicate that crews need about 12 months to practice with new software versions before they become proficient. Under the current test schedule, crews would have only 3 months to become proficient before the FBCB2 Initial Operational Test and Evaluation.

FBCB2 Experimental Results Revealed Problems and Potential for Improvement

Since the FBCB2 program has only recently entered engineering and manufacturing development and is scheduled to undergo about 18 months of testing, no operational evaluations are yet available for analysis. However, a prototype of the system participated in the Task Force XXI Advanced Warfighting Experiment, which concluded in March 1997. The experimental results were analyzed by the Army's Operational Test and Evaluation Command and DOD's Director, Operational Test and Evaluation.

The Army's Operational Test and Evaluation Command's comprehensive Live Experiment Assessment Report offered various assessments of the FBCB2 prototype. The report candidly discussed poor message completion rates, difficulty with message formats, and the limitations of the

experimental hardware and software. The report also acknowledged that potential exists for future improvements. The report offered the following recommendations for the continued development and maturity of the FBCB2 system: (1) continuing to experiment with Applique/FBCB2 using other interface devices, evolving to a voice activated, hands-free system; (2) determining the most critical/useful functions and eliminate noncritical functions; (3) improving vehicle hardware integration; and (4) continuing to develop and mature the Applique Combat Service Support functions.

The Director, Operational Test and Evaluation, through the Institute for Defense Analyses, assessed and evaluated the battlefield digitization aspects of the Task Force XXI Advanced Warfighting Experiment in order to achieve early operational insights before the beginning of formal operational testing. Specific systems observed were the Applique and the Tactical Internet. The oversight effort was conducted in partnership with the Army's Operational Test and Evaluation Command, in recognition of the unique nature of the experiment (as distinct from an operational test). The Director's report also identified a lack of (1) adequate digital connectivity; (2) maturity of the Applique and the Tactical Internet; (3) adequate tactics, techniques, and procedures for operations with digital equipment; and (4) tactical skills resulting from inadequate unit collective training. The report recommended continued oversight and evaluation of the upcoming operational tests of FBCB2. Army program officials currently assess the program's technical risk as medium.

Conclusions and Recommendations

Even though FBCB2 is one of the Army's top priorities and a key component of the systems needed to field the first digitized division, the Army has not designated the program as a category I acquisition. The Army believes that the program does not meet the required dollar threshold for a category I acquisition on the basis of total research, development, test, and evaluation costs. Program management officials have also expressed concern that the additional review and data collection requirements associated with a category I designation would delay the program. They contend that such a delay would prevent them from achieving the goal of fielding the first digitized division by the end of fiscal year 2000.

In our opinion, the significance of the program; its estimated research, development, test, and evaluation cost; and the high schedule risk are compelling reasons for greater oversight. Accordingly, we believe elevating the program to a category I designation would help ensure that adequate management information is developed and provided to

decisionmakers to reduce risk, ensure affordability, and better achieve the objectives of DOD Regulation 5000.2R.

Therefore, we recommend that the Secretary of Defense direct the Under Secretary of Defense for Acquisition and Technology to

- consider our analysis of the FBCB2 program and make a determination of whether it should be appropriately characterized as an acquisition category I-D on the basis of its significance to the Army's battlefield digitization goal, the costs we discuss in this report, schedule risk, the new Army cost estimate expected to be available by the end of this fiscal year, and the benefits of prudent oversight and
- analyze, regardless of eventual category designation, the risks and likely immediate benefits associated with equipping a division with an FBCB2 capability by the end of fiscal year 2000 and provide guidance to Army acquisition executives on managing those risks.

Agency Comments

In commenting on a draft of this report, DOD did not agree nor disagree with our recommendations. In its response, DOD made two points. First, DOD indicated that Overarching Integrated Product Teams—chaired by high level DOD officials—are addressing the issues discussed in our report and that a decision would be made on acquisition level categorization by the fourth quarter of fiscal year 1998. Second, DOD stated that risk management efforts and digitization benefits are continuing to be discussed. DOD described illustrative risk mitigation activities developed by Army officials and reiterated its support of the Army's digitization efforts.

While it appears that the FBCB2 acquisition category issue will be resolved by the end of this fiscal year, we remain concerned about the cost, schedule, and performance risks associated with equipping a division by the end of fiscal year 2000 and the implications of not fielding an adequately developed system by that deadline. We continue to believe that this program should be designated an acquisition category 1-D and that departmental guidance should be provided to the Army on managing the risks of not meeting such a short-term mandated deadline.

DOD's comments are reprinted in their entirety in appendix I, along with our evaluation. In addition, DOD provided technical comments that have been incorporated, as appropriate, in the report.

Scope and Methodology

To evaluate the significance of the FBCB2 program, we reviewed the objectives of the Army XXI and Army After Next initiatives, the priority of FBCB2 within the Army's digitization programs, system comparability with other Army command and control programs, and an assessment of FBCB2's significance prepared by the Office of the Secretary of Defense's Operational Test and Evaluation Office. We also analyzed early Army actions to maintain the system's schedule for equipping the first digitized division.

To evaluate program cost estimates, we reviewed the Army's life-cycle cost estimate; converted research, development, test, and evaluation estimates to fiscal year 1996 dollars; compared the fiscal year 1999 FBCB2 budget request with amounts contained in the life-cycle cost estimate; analyzed the fiscal year 1997 and 1998 amounts appropriated to the Army for FBCB2-related Force XXI Initiatives; and developed estimates of costs incurred by Abrams and Bradley program managers for FBCB2-related activities and test and evaluation costs funded outside the FBCB2 program element. We also analyzed early program cost experiences, particularly the reprogramming action requested for the fiscal year 1998 FBCB2 unfunded requirement.

To evaluate the feasibility of the Army's fielding schedule, we analyzed the events within the FBCB2 schedule; discussed the events with appropriate officials, including representatives of the Abrams and Bradley program offices; and obtained assessments of the risks associated with fielding an FBCB2 capability to an Army division by the end of fiscal year 2000.

In reviewing experimental performance results of the FBCB2 prototype at the Task Force XXI Advanced Warfighting Experiment, we considered the Army's Operational Test and Evaluation Command's Live Experiment Assessment Report and the Director, Operational Test and Evaluation, briefing on early operational insights. In addition, in March 1997, prior to the request for this work, we attended the Force XXI Advanced Warfighting Experiment at Fort Irwin and accompanied representatives of the Operational Test and Evaluation Command to observe and obtain first hand knowledge of the performance of FBCB2 and other initiatives being tested. We also attended after action sessions in which activities carried out during the exercise were evaluated by top commanders.

In the course of our work, we also interviewed program officials and examined program management and budget documents, draft system requirements, draft test plans, acquisition plans, and other program

documentation. We performed work primarily at the Army Digitization Office, Arlington, Virginia, and the Army Communications and Electronics Command, Fort Monmouth, New Jersey. We also gathered data from the Army Tank Automotive and Armaments Command, Warren, Michigan; Director, Operational Test and Evaluation, Arlington, Virginia; Director, Test, Systems Engineering, and Evaluation, Arlington, Virginia; Army Operational Test and Evaluation Command, Alexandria, Virginia; and the Division XXI Advanced Warfighting Experiment, Fort Hood, Texas. Because the FBCB2 Operational Requirements Document is not yet final, we were unable to review an approved version of program requirements.

We performed our review from September 1997 to April 1998 in accordance with generally accepted government auditing standards.

We are sending copies of this report to other appropriate congressional committees; the Director, Office of Management and Budget; the Secretaries of Defense, the Army, the Navy, and the Air Force; and the Commandant of the Marine Corps. Copies will also be made available to others upon request.

Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. The major contributors to this report were Charles F. Rey, Robert J. Dziekiewicz, and Paul G. Williams.

Sincerely yours,

Allen Li
Associate Director,
Defense Acquisitions Issues

Comments From the Department of Defense

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
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WASHINGTON, DC 20301-6000

June 5, 1998

COMMAND, CONTROL,
COMMUNICATIONS, AND
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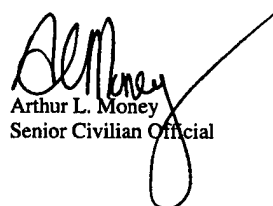Washington, D.C. 20548

Dear Mr. Li:

This is the Department of Defense (DoD) response to the General Accounting Office
(GAO) draft report, "BATTLEFIELD AUTOMATION: Acquisition Issues Facing the Army
Battle Command, Brigade and Below Program," dated May 18, 1998 (GAO Code 707284/OSD
Case 1620).

The DoD has been exercising its oversight responsibilities of the Army's digitization
efforts since their very inception. To reinforce this oversight, the Department established
reviews by the Overarching Integrated Product Teams (OIPT) for both Army Battlefield
Digitization and Force XXI Battle Command Brigade and Below (FBCB2), which are directly
involved in the issues identified in your report--none of which are new. All have been a
significant part of various discussions associated with the OIPTs. Specific comments to the
GAO recommendations are enclosed. Additional technical corrections were provided separately
to the GAO staff.

The Department is fully supportive of the Army's digitization efforts as they are a major
contributor to achieving Joint Vision 2010. Our OIPT process has been successful in the past in
resolving similar issues.

The DoD appreciates the opportunity to comment on the GAO draft report.

Sincerely,

Arthur L. Money
Senior Civilian Official

Enclosure

GAO DRAFT REPORT DATED MAY 18, 1998
(GAO CODE 707284) (OSD CASE 1620)

"BATTLEFIELD AUTOMATION: ACQUISITION ISSUES FACING THE
ARMY BATTLE COMMAND, BRIGADE AND BELOW PROGRAM"

DEPARTMENT OF DEFENSE COMMENTS TO
THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommended that the Secretary of Defense direct the
Under Secretary of Defense for Acquisition and Technology to consider the GAO analysis of the
Force XXI Battle Command, Brigade and Below (FBCB2) Program and make a determination of
whether it should be appropriately characterized as an acquisition category I-D on the basis of its
significance to the Army's battlefield digitization goal, the costs discussed in the report, schedule
risk, the new Army cost estimate expected to be available by the end of this fiscal year, and the
benefits of prudent oversight. (pp. 23-24/GAO Draft Report)

DOD RESPONSE: The Under Secretary of Defense for Acquisition and Technology
(USD(A&T)), through his Director of Strategic and Tactical Systems, and the Assistant
Secretary of Defense for Command, Control, Communications and Intelligence (ASD(C3I)),
through his Deputy Assistant Secretary of Defense for Command, Control, Communications and
Intelligence Acquisition (DASD(C3IA)) have co-chaired the OIPT on Army Battlefield
Digitization and are planning an FBCB2 OIPT this summer. These OIPTs are addressing the
issues discussed in the GAO report. Several working level IPT meetings have been held to
clarify a number of the issues. With regard to costs, the OSD Cost Analysis Improvement Group
(CAIG) is currently working with the Army's Cost and Economic Analysis Center (CEAC) to
validate the FBCB2 program costs. This effort should be completed during the 4th quarter,
FY 98. The OIPT for FBCB2 will likely make a recommendation for the acquisition category
(ACAT) level for FBCB2 to the USD(A&T) prior to the end of this fiscal year.

RECOMMENDATION 2: Regardless of the eventual category designation, the GAO
recommended that the Secretary of Defense direct the Under Secretary of Defense for
Acquisition and Technology to analyze the risks and likely immediate benefits associated with
equipping a division with an FBCB2 capability by the end of fiscal year 2000 and provide
guidance to Army acquisition executives on managing those risks. (p. 24/GAO Draft Report)

DOD RESPONSE: As part of the OIPT for FBCB2 process, risk management efforts and
digitization benefits have been and are continuing to be discussed. The Army is using the spiral
model development process which is a commercially accepted practice for software-intensive
systems such as FBCB2. This model employs an iterative process of continuous user
involvement during development and testing in order to provide immediate feedback to reduce
risk and ensure the final product meets the user requirements. A working group is planned to
further evolve this new concept for software development. The goal of the working group will
be to revise the DoD acquisition policy and procedures for software-intensive systems to
accommodate this new software development model in the spirit of acquisition streamlining.
The FBCB2 program manager has also developed a risk mitigation strategy involving a series of
tests to be conducted prior to the October 1999 initial operational test and evaluation (IOTE).
These tests include two technical field tests at the Army Electronic Proving Grounds at Fort

Now on p. 18.

See comment 1.

Now on p. 18.

See comment 2.

Huachuca, Arizona, in May 1998 and May 1999, a limited user test (LUT) at Fort Hood, Texas, in August 1998, and a force development test and evaluation (FDTE) in August 1999. The OIPT process will provide additional guidance on risk mitigation as needed.

The benefits of digitization and FBCB2 are of great interest to the DoD. The 1997 Force XXI and Division Army Warfighting Experiments (AWE) demonstrated significant potential for the Army to achieve information dominance with resulting significant increases in lethality, survivability, and optempo. This was further substantiated with subsequent modeling and simulation. An operational assessment of the first digitized division is planned for 2001 in order to provide a more accurate assessment of the increased force effectiveness accruing from digitization.

The following are GAO's comments on the Department of Defense's (DOD) letter dated June 5, 1998.

GAO Comments

1. DOD commented that through Integrated Product Team meetings the issues such as program significance, cost, and schedule risk—discussed in our report—are being addressed. Although DOD did not elaborate on how the teams were addressing the issues of significance or schedule risk, it did acknowledge that the Office of the Secretary of Defense's Cost Analysis Improvement Group is currently working with the Army's Cost and Economic Analysis Center to validate the Force XXI Battle Command, Brigade and Below (FBCB2) program costs. This effort is expected to be completed by the fourth quarter of fiscal year 1998. In our opinion, the results of this analysis, as well as the information we have presented on program significance and schedule risk, should be considered in developing the actions taken in response to our recommendation.

2. DOD commented that the spiral software development, the series of tests that have started or are scheduled to be conducted prior to the October 1999 Initial Operational Test and Evaluation, and guidance from the Overarching Integrated Product Team all provide some degree of risk management. We continue to believe these actions do not constitute an adequate risk mitigation strategy for the reasons discussed in the body of our report and summarized as follows

- Even with the guidance of the Overarching Integration Product Team, the fact that so many system development tests are being compressed to meet a 18-month schedule because of the mandated fiscal year 2000 deadline is, in our view, a high risk approach to successful system development.
- The spiral software development model discussed by DOD will not guarantee success. Even with users involved during the frequent tests, it is unlikely that there is enough time between tests for DOD to adequately correct discovered deficiencies and implement other desired changes. Further, DOD states that a working group is planned to evolve this spiral development concept for software in the spirit of acquisition streamlining. We believe that the time for evolving this concept, as it relates to FBCB2, is past, and concentrated effort must be focused on successfully completing the scheduled tests and containing escalating costs.
- DOD is proceeding with FBCB2 development on the basis of an Operational Requirements Document and a Test and Evaluation Master Plan, which are still in the process of being reviewed for approval by the Joint Requirements Oversight Council. This, in our opinion, is another

impediment to adequate risk mitigation because DOD is attempting to develop a system that may or may not be addressing appropriate requirements.

We still believe that the discussion in our report on these issues supports the need for DOD and the Army to follow the more formal approach to risk mitigation planning as required by DOD Regulation 5000.2R for acquisition I programs.